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VALIDATION OF THE ETA WS REGIONAL CLIMATE MODEL DRIVEN BY BOUNDARY CONDITIONS FROM THE HADAM3H OVER SOUTH AMERICA

Pisnichenko, I.A.*, T.A. Tarasova, J.P.R. Fernandez, and J. Marengo
Centro de Previsão de Tempo e Estudos Climáticos, Cachoeira Paulista, SP, Brazil

1. Introduction

The large-scale climate fields (>500 km) of principal meteorological parameters are well known and actively analyzed in the works on the climate theory. Needs of agriculture, industrial and energy development planning require the knowledge of detailed, regional and local scale (100km - 10 km) climatic information. As the modern net of climate observation stations can supply data only suited for large-scale climate field investigations, the dynamical downscaling using high-resolution regional climate model (RCM) is the most powerful instrument for obtaining smaller-scaled climate information. For the study of regional climate change in the future the dynamical downscaling is the only way to obtain necessary information.

The dynamical downscaling approach involves RCM forced at the lateral boundaries and bottom boundary by an atmospheric-ocean general circulation model (AOGCM) or reanalyses data. The finer regional-scale features of RCM can be attributed to detailed topography and land surface features, more comprehensive parameterization of unresolved physical processes in the model equations, and explicit simulating of large mesoscale processes.

The studies of downscaling over South America are relatively few as compared with those made over other continents. Most of them are limited to integration periods of 1-5 months for 1-3 years (Nobre et al. 2001; Chou et al. 2002; Roads et al. 2003; Misra et al. 2003; Sun et al. 2005; Tarasova et al. 2006). The impact of the Andean topography, different land surface types, and radiation schemes on the model performance, was studied in these works. Analysis of the integration results demonstrates in some cases a significant improvement of climate information as compared with AOGCM. It was noted that after downscaling the surface temperature and precipitation in the interior of the continent during wet months became more close to observation data, the high-frequency precipitation statistics in the north-east part of Brazil were improved, some AOGCM biases relatively observations were corrected.

In the above mentioned investigations there were used different RCM such as NCEP Eta, NCEP RSM, RegCM2, ECPCRSM, GISSRCM, FSUNRSM. It seems a good idea to use various long-period simulations over South America with different regional models to resolve the problem of coarse AOGCMs data improvement. By analyzing the multiple model simulation results the causes of the model systematic errors can be revealed as well as multiple model ensemble results can be used.

* Corresponding author address: Igor A. Pisnichenko, CPTEC/INPE, Rodovia Presedente Dutra, km. 40, 12630-000, Cachoiera Paulista, SP, Brazil.
E-mail: pisnitch@cptec.inpe.br

2. Eta climate model

We started our investigations using the regional EtaWS (workstation) model with horizontal resolution of 40 km (Mesinger et al., 1988). To perform climate running the original version of weather forecasting Eta WS model was strongly modified. There were made multiple changes and corrections between which we can emphasize a) preparing of the interface that allows the ETA model starts from HadAM3H data and use them for time dependent boundary conditions; b) modification of the SST update program to use SST data generated by HadCM3; c)modification of the incident solar radiation programs to use the 360 days year HadAM3H data; d) preparing restart programs that permit to continue running model from any time moment using output binary files; e) correcting all shortcomings that don't permit to run the model for the period more than 3 months. This version of the model has been integrated over South America for the periods 1961-1972, 1981-1983, 2070-2081, The model was forced at its lateral boundaries by the output of HadAM3H. The running of Eta WS climate model (Eta WSCM) was made on the supercomputer SX6.

3. Results of downscaling and future plans

The detailed analysis of the integration results is currently making. At first we have to show a consistency between AOGCM and RCM output. In order to do it we compare the RCM field data smoothed to AOGCM grid with corresponding AOGCM data. For example, we've calculated bias and root-mean square errors for temperature and geopotential monthly fields and analyzed their temporal behavior. Also we've compared spectrum of various meteorological parameters such as temperature, geopotential, kinetic energy averaged over specific areas. From previous analysis we can conclude that RCM doesn't significantly diverge from AOGCM.

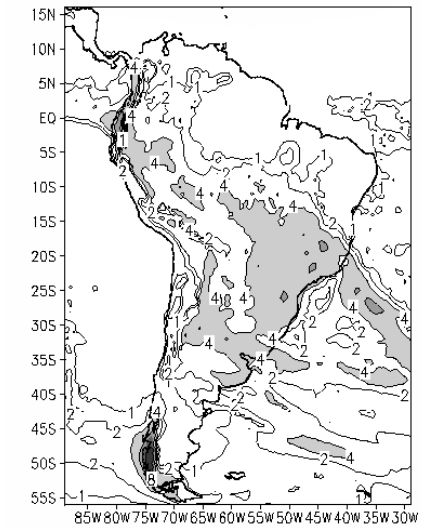

Figure 1. January 1983 mean precipitation (mm/day) from the Eta WSCM model integration.

The simulated monthly means of precipitation and near surface air temperature also were compared with the GPCP (Huffman et al., 2000) and CRU observations. We can see from Fig.1 and Fig.2 that in essential features the model-simulated and satellite-derived precipitation fields are similar. Noting here that the parallel runs of the Eta WS model forced at its lateral boundaries by NCEP/DOE Reanalysis II data was made. As it was expected this run fields are more close to those of GPCP and CRU, but the difference is not crucial. We hope that further analysis of this difference will aid in the identification of the causes of divergences and help to tune better the RCM.

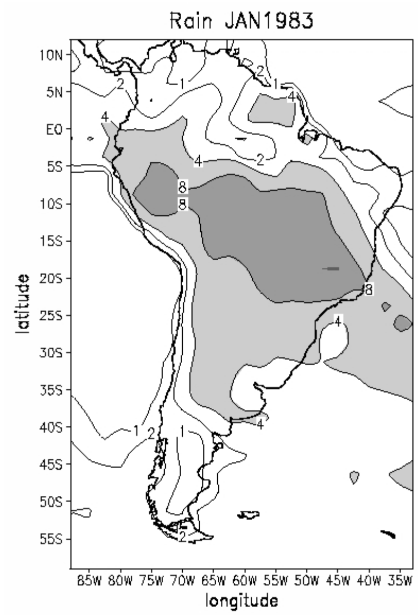

Figure 2. January 1983 mean preciptation (mm/day) from GPCP data.

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